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| IDENTIFIERS | Florida; *Quinmester Program |

ABSTRACT

This automotive engines course studies and demonstrates the theory and principles of operation of the automotive four stroke cycle engine. The student will develop an understanding of the systems necessary to make the engine perform as designed, such as cooling, fuel, ignition and lubrication. This is a one or two quinmester credit course of 45 clock hours. It is the third course in the tenth grade. Included in this course is an introduction to the theory of operation of the internal combustion engine. Part of this document includes a course outline and a seven page section of post tests. (DS)

ED 092705

VT

AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

V-30

Course Outline
AUTOMOTIVE MECHANICS 1 - 9043
(Automotive Engines)
Department 48 - Quin 9043.03

CE001434

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1973

ED 092705

DADE COUNTY PUBLIC SCHOOLS

1450 NORTHEAST SECOND AVENUE

MIAMI, FLORIDA 33132

Course Outline

# AUTOMOTIVE MECHANICS 1 - 9043
(Automotive Engines)

Department 48 - Quin 9043.03

county office of

VOCATIONAL AND ADULT EDUCATION

THE SCHOOL BOARD OF DADE COUNTY

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Dr. E. L. Whigham, Superintendent of Schools
Dade County Public Schools
Miami, Florida 33132

February, 1973

Published by the School Board of Dade County

## Course Description

| 9043 | 48 | 9043.03 | Automotive Engines |
|---|---|---|---|
| State Category Number | County Dept. Number | County Course Number | Course Title |

The theory and principles of operation of the automotive four stroke cycle engine are studied and demonstrated. The student will develop an understanding of the systems necessary to make the engine perform as designed; such as cooling, fuel, ignition and lubrication. Demonstrations will be made by the instructor when necessary. This is a one or two quinmester credit course.

Prior to entry into this course, the vocational student will display mastery of the skills indicated in Automotive Chassis (9043.02).

Clock Hours: 45

# PREFACE

The following pages contain a course outline entitled, Automotive Engines. This is the third quinmester course in the tenth grade, course 9043.

The quinmester course is 45 hours in length and will be available to all students who satisfactorily complete course 9043.02. This outline consists of four blocks of instruction which are sub-divided into several units each. It includes an introduction to the theory of operation of the internal combustion engine. The function of the individual parts and their relationship to each other are studied. The instruction will consist of lectures, demonstrations and group discussions. Audio visual aids will be used to supplement instruction. The students will perform only minor dis-assembly and service as a group, with the instructor explaining the function of the parts as they are dis-assembled.

The bibliography appearing on the last page of the outline lists several basic references along with supplementary references and audio visual aids.

This outline was developed through the cooperative efforts of the instructional and supervisory personnel, the Quinmester Advisory Committee and the Vocational Curriculum Materials Development Services, and has been approved by the Dade County Vocational Curriculum Committee.

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BLOCK

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| I. AUTOMOTIVE ENGINE DESIGN (5 Hours) | |
| Development of the Internal Combustion Engine | 1 |
| Identifying Types of Engines | 1 |
| II. PISTON TYPE ENGINE (30 Hours) | |
| Nomenclature and Function of Basic Parts | 1 |
| The Four Stroke Cycle | 1 |
| The Block Assembly | 1 |
| The Head Assembly | 2 |
| The Lubrication System | 2 |
| The Cooling System | 3 |
| The Fuel System | 3 |
| The Ignition System | 3 |
| III. ROTARY ENGINE (5 Hours) | |
| Principle of Operation | 4 |
| Construction Features | 4 |
| Advantages | 4 |
| Disadvantages | 4 |
| IV. TURBINE ENGINE (5 Hours) | |
| Principle of Operation | 4 |
| Construction Features | 4 |
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| The Head Assembly | 2 |
| The Lubrication System | 2 |
| The Cooling System | 3 |
| The Fuel System | 3 |
| The Ignition System | 3 |
| III. ROTARY ENGINE (5 Hours) | |
| Principle of Operation | 4 |
| Construction Features | 4 |
| Advantages | 4 |
| Disadvantages | 4 |
| IV. TURBINE ENGINE (5 Hours) | |
| Principle of Operation | 4 |
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| Advantages | 4 |
| Disadvantages | 4 |
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## GOALS

The automotive mechanic trainee must be able to demonstrate:

1. An understanding of the function and theory of operation of the internal combustion automotive engine.

2. The ability to interpret the sectional drawings of the engine, its sub-assemblies and related systems.

3. Attitudes which are acceptable in the automotive repair industry. These attitudes will be measured by the student's record of attendance completion of assignments, and cooperation with instructors and fellow students.

## SPECIFIC BLOCK OBJECTIVES

### BLOCK I - AUTOMOTIVE ENGINE DESIGNS

The student must be able to:

1. Identify in wiriting the various types of engines.

### BLOCK II - PISTON TYPE ENGINE

The student must be able to:

1. Identify in writing the various parts of the engine and its sub-assemblies.
2. Demonstrate an understanding of the principles of operation of a four stroke cycle engine by successfully passing a written test.
3. Demonstrate an understanding of the engine lubrication system by successfully passing a written test.
4. Explain orally or in writing the principles of operation of the cooling system and its related parts.
5. Explain orally or in writing the principles of operation of the fuel system and its related parts.
6. Explain orally or in writing the principles of operation of the ignition system and its related parts.

### BLOCK III - ROTARY ENGINE

The student must be able to:

1. Explain orally the advantages and disadvantages of the rotary engine.

### BLOCK IV - TURBINE ENGINES

The student must be able to:

1. Explain orally the advantages and disadvantages of the turbine engine.

### BLOCK V - QUINMESTER POST-TEST

The student must be able to:

1. Satisfactorily complete the quinmester post-test.

Course Outline

AUTOMOTIVE MECHANICS 1 - 9043
(Automotive Engines)

Department 48 - Quin 9043.03

I. AUTOMOTIVE ENGINE DESIGNS

A. Development of the Internal Combustion Engine

B. Identifying Types of Engines
   1. Cylinder arrangements
      a. Inline
      b. V
      c. Opposed
   2. Valve arrangement
      a. I head
      b. F head
      c. L head
   3. Strokes per cycle
      a. Four stroke cycle
      b. Two stroke cycle
   4. Cooling methods
      a. Liquid cooled
      b. Air cooled
   5. Fuel used
      a. Gasoline
      b. Diesel
   6. Compression method
      a. Piston
      b. Rotor
   7. Cam location
      a. Block
      b. Overhead

II. PISTON TYPE ENGINE

A. Nomenclature and Function of Basic Parts
   1. Cylinder
   2. Piston and connecting rod assembly
   3. Crankshaft
   4. Valves

B. The Four Stroke Cycle
   1. Intake
   2. Compression
   3. Power
   4. Exhaust

C. The Block Assembly
   1. The engine block construction and function
      a. Purposes of water and oil passages
      b. Welch plugs

2. The crankshaft construction and function
   a. Oil passages
   b. Method of transferring oil from block to crankshaft
   c. Bearings
   d. Flywheel
   e. Vibration damper
3. Piston and rod assembly
   a. The piston
      (1) Construction features and functions
      (2) Lands
      (3) Grooves
      (4) Rings
      (5) Lubrication
      (6) Piston Pin
   b. The connecting rod
      (1) Construction
      (2) Function
4. The valve operating mechanism
   a. The camshaft
      (1) Construction and function
      (2) Lubrication
   b. The valve lifter
      (1) Types
      (2) Construction and function
      (3) Principles of operation
   c. The push rods
      (1) Construction
      (2) Function
   d. Gears, sprockets and timing chains
      (1) Construction and function
      (2) Principles of operation
      (3) Lubrication
      (4) Timing methods and techniques
5. The Flywheel
   a. Construction
   b. Function

D. The Head Assembly
1. The head
   a. Construction features and function
   b. Water and oil passages
   c. Valve guides
2. The valves
   a. Construction and function
   b. Lubrication methods
   c. Cooling
3. The rocker arms
   a. Identification of parts
   b. Construction features and functions
   c. Methods of lubrication

E. The Lubrication System
1. The oil pump
   a. Construction and function
   b. Types
   c. Pressure control system

II. PISTON TYPE ENGINE (Contd.)

2. The oil filter
   a. Types
   b. Construction and function
3. Oil passages and nozzles
   a. Purposes
   b. Methods of routing and distributing oil
      (1) Force
      (2) Splash
      (3) Squirt holes
4. The oil pan and reservoir
   a. Purpose
   b. Methods

F. The Cooling System
1. The water pump
   a. Construction and function
   b. Drive belt
   c. Fan
2. Thermostat
   a. Types
   b. Construction and function
3. The radiator
   a. Construction and function
   b. Radiator cap
   c. Hoses
   d. Overflow recovery systems
   e. Safety precautions

G. The Fuel System
1. Fuel pumps
   a. Types
   b. Construction and function
   c. Principles of operation
2. Carburetors
   a. Types
   b. Construction and function
   c. Principles of operation
3. The intake system
   a. Types
   b. Construction and function
4. The exhaust system
   a. Construction and function
   b. Heat control valves
   c. Mufflers

H. The Ignition System
1. The primary circuit
   a. Battery
      (1) Construction and function
      (2) Principles of operation
   b. The coil
      (1) Construction and function
      (2) Principles of operation
      (3) The ballast resistor

c. The distributor
(1) Principles of operation
(2) Function of the contact points
(3) Function of the cam

2. The secondary circuit
a. The coil secondary function
b. The distributor secondary
(1) Operation and function of the rotor and cap
(2) The secondary wiring
(3) Spark plugs
(a) Types
(b) Operation and function

III. ROTARY ENGINE

A. Construction Features

B. Advantages

C. Disadvantages

D. Principles of Operation

IV. TURBINE ENGINE

A. Principles of Operation

B. Construction Features

C. Advantages

D. Disadvantages

V. QUINMESTER POST-TEST

BIBLIOGRAPHY
(Automotive Engines)

Basic References:


1. Crouse, William H. Automotive Engines. New York: Webster Division, McGraw-Hill Book Company, 1966. Pp. 626.

2. _____. Automotive Mechanics. 5th ed. New York: Webster Division, McGraw-Hill Book Company, 1965. Pp. 616.


Supplementary References:


3. Chilton Auto Repair Manual. 35th ed. Philadelphia: Chilton Company, 1964. Pp. 1250.

4. Glenn Auto Repair Manual. 34th ed. Philadelphia: Chilton Company, 1962. Pp. 478.

5. Motors Auto Repair Manual. 27th ed. New York: Motor Magazine, 1964. Pp. 1230.

6. Stockel, Martin W. Auto Mechanics. Chicago: Goodheart-Willcox Company, Inc., 1963. Pp. 480.

7. _____. Auto Mechanics Fundamentals. Illinois: Goodheart-Willcox Company, Inc., 1969. Pp. 480.

8. Tobolt, William K., and Johnson, Larry. Motor Services Automotive Encyclopedia. Illinois: Goodheart-Willcox Company, Inc., 1970. Pp. 768.

# A P P E N D I X

## Quinmester Post-Test Sample

QUINMESTER POST-TEST

NAME _____ DATE _____ SCORE ____

Each statement needs a phrase or word to make it correct. Please circle the correct answer.

1. An engine that has two rows of cylinders arranged horizontally along both sides of the crankcase is a:

   a. Inline engine
   b. V type engine
   c. Opposed engine
   d. Water cooled engine

2. An engine that has both intake and exhaust valves located in the head would be a:

   a. I head
   b. F head
   c. L head
   d. B head

3. If the crankshaft in a V-8 engine had to rotate twice to fire all 8 cylinders once, this engine would be described as a:

   a. Rotary engine
   b. "Two cycle" engine
   c. Overhead cam engine
   d. "Four cycle" engine

4. The correct operating sequence of strokes in a four stroke cycle engine are:

   a. Intake, power exhaust, compression
   b. Intake, compression, power, exhaust
   c. Exhaust intake power, compression
   d. Power, compression intake, exhaust

5. The piston moves upward or outward toward the head on <u>both</u> the:

   a. Intake and power strokes
   b. Compression and exhaust strokes
   c. Compression and power strokes
   d. Exhaust and intake strokes

6. Oil is fed to the crankshaft oil passages:

   a. Through oil passages in the block
   b. Through the connecting rods
   c. By squirt nozzles in the cylinder walls
   d. By gear fittings in the side of the block

7. Oil rings on the piston:

   a. Scrape oil from the piston
   b. Help lubricate the piston
   c. Scrape oil from the cylinder wall
   d. Pump oil around the piston

8. Camshafts are generally made of:

   a. Aluminum
   b. Bronze
   c. Stainless steel
   d. Cast iron

9. The function of the lobes on the camshaft is to:

   a. Balance the shaft
   b. Sling oil onto the cylinder wall
   c. Operate the timing chain
   d. Operate the valves

10. The camshaft is driven at:

   a. Half the crankshaft speed
   b. Twice the crankshaft speed
   c. The same speed as the crankshaft
   d. 2000 R.P.M. always

11. An advantage that hydraulic valve lifters have over solid lifters is:

   a. They are cheaper to make
   b. They need no servicing
   c. They use no oil
   d. They operate quietly

12. Valve timing on engines is usually done:

   a. By aligning marks
   b. With a stop watch
   c. By measuring valves
   d. By adjusting clearances

13. When the piston is moving down on intake stroke, the:

   a. Intake valve is closed - exhaust valves open
   b. Intake valve is open - exhaust valve is open
   c. Intake valve is open - exhaust valve is closed
   d. Intake valve is closed - exhaust valve is closed

14. When the piston is moving up on the compression stroke, the:

   a. Intake valve is closed - exhaust valve is open
   b. Intake valve is open - exhaust valve is open
   c. Intake valve is open - exhaust valve is closed
   d. Intake valve is closed - exhaust valve is closed

15. Exhaust valves get extremely hot. This heat must be dissipated:

    a. Through the seat when the valve is open
    b. Through the seat when the valve is closed
    c. Through the stem into the rocker arm
    d. Through the margin into the air

16. Badly worn crankshaft bearings can cause:

    a. Block exhaust smoke
    b. Engine noises
    c. Low gas mileage
    d. Poor acceleration

17. On a four cycle engine, the camshaft turns:

    a. Always counterclockwise
    b. Always clockwise
    c. At 1/2 the speed of the crankshaft
    d. Twice the speed of the crankshaft

18. Piston displacement is calculated from the:

    a. Bore and stroke
    b. Cylinder length and diameter
    c. Piston length and diameter
    d. Clearance volume

19. Engine valves are closed by:

    a. Camshaft pressure
    b. Valve lifter pressure
    c. Oil pressure
    d. Spring pressure

20. Holes or slots are provided in the piston oil ring groove to help:

    a. Return oil to crankcase
    b. Cool the piston
    c. Lubricate cylinder walls
    d. Stop blow by

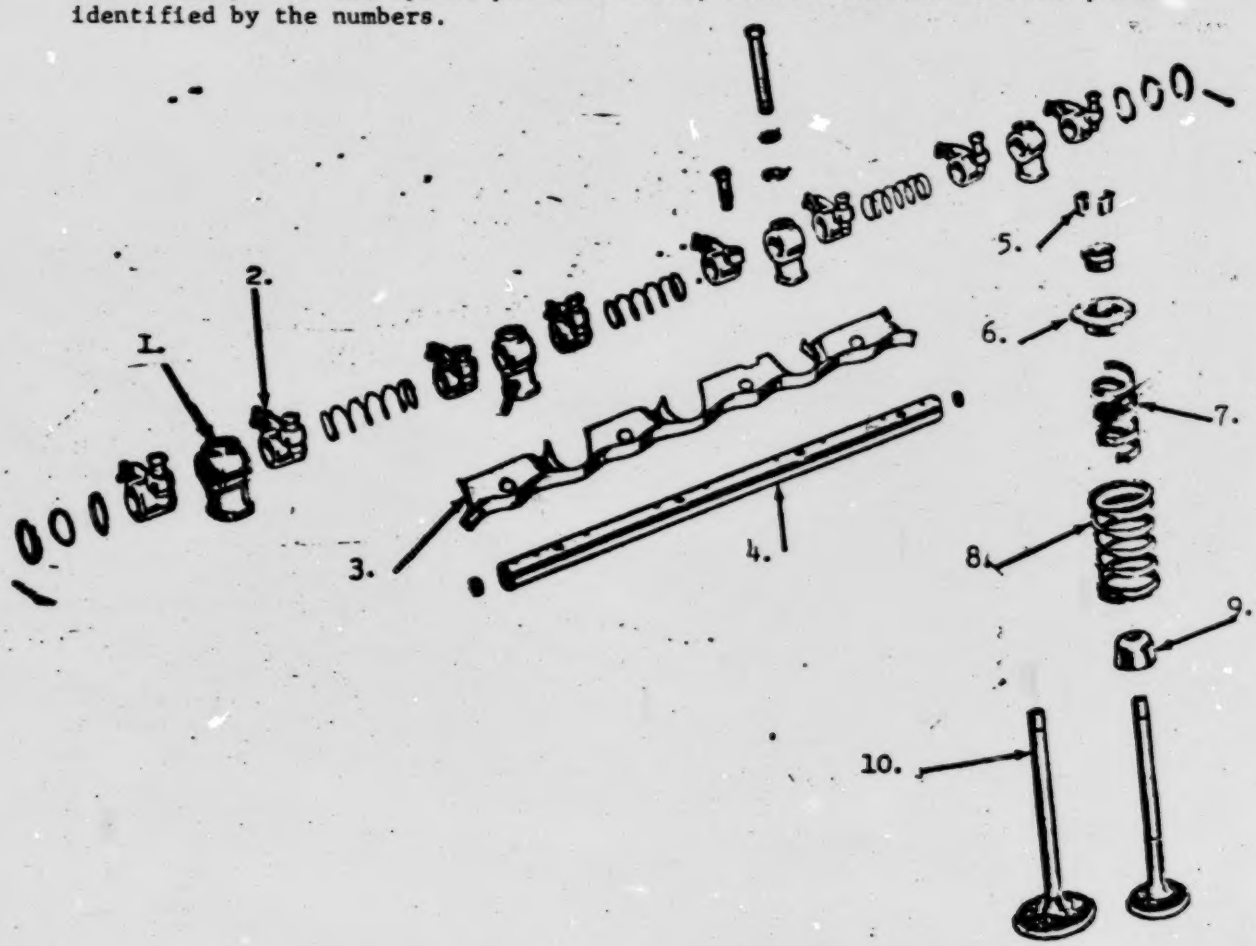
## Quinmester Post-Test

Name _____ Date _____ Score ____

### Identification Test

Valve and Rocker Arm Assembly

Directions - Illustrated below is an exploded view of a valve and rocker arm assembly. In the spaces provided below, write in the name of the parts identified by the numbers.




1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

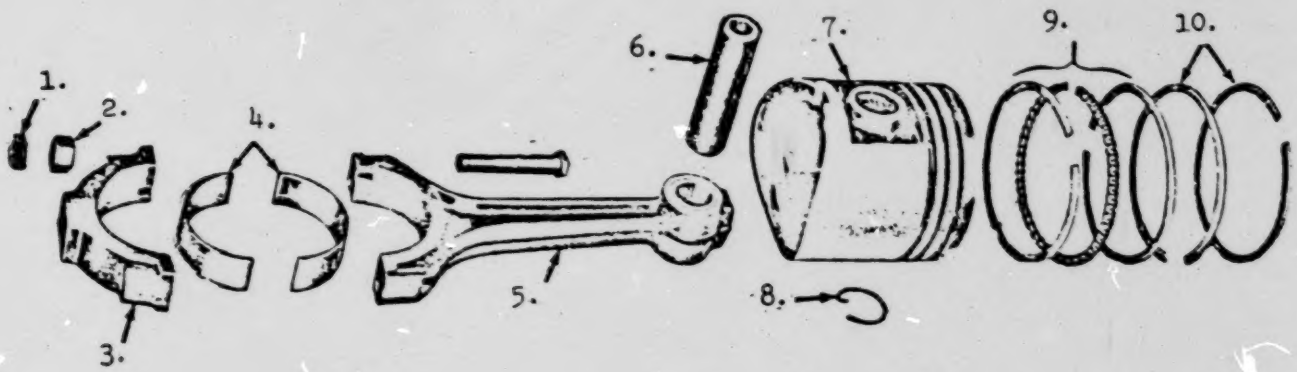
Quinmester Post-Test

Name _____ Date _____ Score ____

## Identification Test

### Piston and Connecting Rod Assembly

Directions - Illustrated below is an exploded view of a piston and rod assembly. In the spaces provided, write in the names of the parts identified by the numbers.




1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

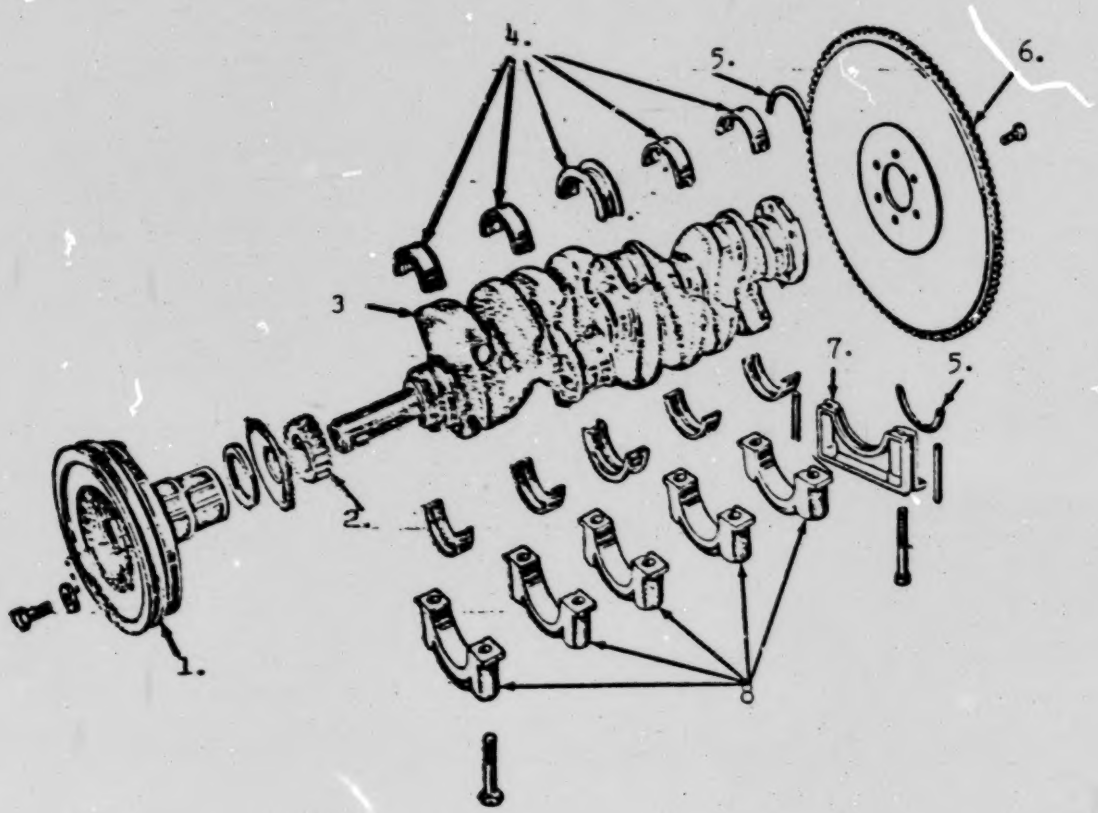
Quinmester Post-Test

Name _____ Date _____ Score _____

Identification Test

Crankshaft and Related Parts

Directions - Illustrated below is an exploded view of a crankshaft assembly and related parts. In the space provided, write in the names of the parts identified by the numbers.




1. _____ 5. _____

2. _____ 6. _____

3. _____ 7. _____

4. _____ 8. _____

# ANSWER KEY TO QUINMESTER POST-TEST

## Multiple Choice

1. c
2. a
3. d
4. b
5. b
6. a
7. c
8. d
9. d
10. a
11. d
12. a
13. c
14. d
15. b
16. b
17. c
18. a
19. d
20. a

## Valve & Rocker Arm Test

1. Rocker Shaft Support
2. Rocker arm
3. Oil baffle
4. Rocker shaft
5. Valve keys
6. Valve spring cap
7. Anti-vibration spring
8. Valve spring
9. Oil Seal
10. Valve

## Piston & Rod Assembly Test

1. Lock nut
2. Nut
3. Rod cap
4. Rod bearings
5. Converting rod
6. Piston bin
7. Piston
8. Snap ring
9. Oil ring assembly
10. Compression rings

## Crankshaft & Related Parts Test

1. Pulley
2. Crankshaft gear
3. Crankshaft
4. Main bearings
5. Rear main oil seals
6. Flywheel
7. Rear main seal
8. Main bearing caps